Mapping of Overdose Detection and Alert Technologies: A Summary

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This report is produced by the Overdose Detection and Responder Alert Technologies (ODART) Project, a partnership between the University of Stirling and St Andrews University and is supported by the Digital Lifelines Scotland of the Drugs Research Network for Scotland (DRNS). In October 2020, the DRNS secured funding from the Scottish Government's Technology Enabled Care (TEC) Program and ODART was launched in February 2021. This report gives a summary of an overview of different technologies developed nationally and internationally to avoid fatal drugs overdose. This report is produced for the Drugs Death Taskforce, Digital Lifelines Scotland and the Drugs Research Network Scotland.

1. Introduction

In the last decade, the number of drug-related deaths (DRD) has rapidly increased in Scotland (National Records of Scotland, 2021). The aim of the Overdose Detection and Responder Alert Technologies (ODART) Project is to transform preventative care for those most at risk of drug-related death by delivering on four main workstreams: 1) detect the onset of overdose and alert a responsible person; 2) overdose first responder; 3) community provision of 'Naloxboxes'; and 4) remote addiction consultations.

The aim of this report is to summarise the problems regarding drug overdoses and scope out and assess the existing technologies developed for preventing drug overdose deaths. This report focuses on workstreams 1 and 2.

2. Methods

We undertook a four-phase process - In this report, we present the results of phases 1 to 3:

1) To identify the needs of our target group, we analysed the recent reports related to high-risk drug use and DRD. We searched both the scientific and grey literature for digital overdose alert and response technologies.

2) To identify applications, searches on different platforms were carried out, contacting key actors, including the companies and researchers creating the technologies to obtain information on their devices and other contextual information they could provide. The technologies of interest are from two categories: a) Devices that can sense the early stage of overdose and alert a first responder; b) Smartphone applications aimed at reducing the risk of fatal overdose.

3) To understand the fit between the needs and application functionality (including applicability, user-friendliness, and shortcomings), four consultation sessions were conducted with people who use drugs (PWUD) and service providers.

4) To understand the role of technology in the prevention of overdose, we undertook a systematic literature review which is in progress – for publication in a peer-reviewed journal.

3. The Scottish context for drug-related deaths

Scotland has the most severe DRD problem in Europe with a new record of 1,339 DRD in 2020, twenty times the number of DRD than the EU average (National Records of Scotland, 2021). More than half of those who died from DRDs had been living alone for all or most of the period before they died. Where known, 62% of people who had a DRD died in their own home and 21% died in another person's home. The percentage of people who died in their own home has increased over time (2009: 51%)(Barnsdale and Graham, 2018).

Almost three quarters (73%) of people who died from a DRD in 2020 were men. After adjusting for age, males were 2.7 times as likely to have a drug-related death as females in 2020. Glasgow and Clyde had the highest drug-related death rate of all health board areas for the 5- year period 2016-2020 (30.8 per 100k population), followed by Ayrshire and Arran (27.2) and Tayside (25.7). Highland (13.3 per 100k population) and Grampian (14.6) had the lowest rates of all the health boards for which these figures are available (National Records of Scotland, 2021). In 2020, after adjusting for age, people in the most deprived areas were 18 times as likely to have a drug-related death as those in the least deprived areas. That ratio has almost doubled in 20 years.

In 2011, the take-home naloxone (THN) programme was introduced by the Scottish Government in response to the rising number of opioid-related deaths (SFAD, 2021). In January 2021, the Scottish Government announced plans to distribute take-home naloxone kits to people at high risk of accidental overdoses. This included those who have been resuscitated by the Scottish Ambulance Service (SAS) following an accidental overdose.

4. Insights from Consultation Groups

We obtained data from four focus groups on the acceptability, strengths and limitations of digital technologies to prevent drug overdoses. Groups discussed the technologies that are being described in this report, namely sensor-based devices to detect overdose and prompt alerts, and smartphone applications to reduce risks. Two of the focus groups involved people with lived experience of opioid use, and two involved people providing services for people at risk of drug overdose, mainly drug treatment services, but also researchers.

Preliminary analysis of the data shows:

- These technologies have been well-received in general.
- Room-based devices are considered easy to implement but not sufficient.
- False positives could undermine acceptability.
- Discreetness and stealth would be very important for these technologies to be acceptable to users.
- Use of smartphones is not generalised. In addition, some vulnerable and older people, are not digitally literate and would need to learn how to use some of the functionalities. The younger and middle-aged PWUD had a higher preference of using digital technology compared to older participants.
- Service providers were very eager to use and support the use of these applications by PWUD.
- Participants highlighted the apps need to be designed with end-users in order to better understand their needs.
- For output of apps, participants suggested that videos and pictures can become interactive.
- Privacy of user data always must be assured, and the vulnerability of this particular group of users should be accounted for throughout the whole system. Personal information which collected through the apps, should not be shared with any third party (e.g., Police).

Based on the analysis of the current situation, our report addresses four key challenges:

Overdosing when alone: This means, there is a need to increase monitoring of PWUD, while considering different aspects such as privacy issues and acceptance of the system by PWUD.

Access to naloxone in an emergency: Although the Scottish government is expanding naloxone distribution, access to naloxone in emergency situations is still a challenge. In emergency situations, individuals need to be able to inform carriers to bring naloxone in a timely manner. If the response time (of ambulance or carriers) is not sufficiently quick, DRD may happen.

Knowledge Gap: Knowledge about drug use and ways to prevent DRD is not sufficient, among families, friends and those individuals and groups who are close to PWUD. To prevent

DRD, there is a need to increase knowledge of drugs use, overdose prevention and ways to avoid overdose death.

Improved access to communities and support: Access to treatment for PWUD is very challenging, in particular for those who use opioids. For a large number of opioid users seeking treatment, the waiting time before being admitted to treatment and starting treatment can take up to 18 weeks which puts those in very vulnerable situations at risk while they wait.

We propose that digital technologies could help to address the above-mentioned challenges. We identified two main groups of digital technologies that can prevent fatal OD: 1) sensor-based technologies that detect physiological signs of OD and prompt an alert; and 2) smartphone applications that increase the chances of a timely response to OD.

5. Devices to detect an overdose and alert first responders

For the sensor technologies, we identified and selected a total of 27 devices. We identified 20 devices that are specifically designed to respond to drug overdoses or are being, or were recently adapted, for this purpose. The different technologies are in different stages of development, from being only prototypes to currently being used in the real world. Ten products are actively being used or adapted for the prevention of ODs. These types of devices include:

- Fixed, room-based devices. These devices are designed to measure signals like respiratory rate or movement in a room
- Wearable/mobile devices. These include sensors such as oximeters or respiratory rate sensors that the person carries on their body, and include closed-loop implants that directly inject naloxone into the body after sensing, wristbands/smartwatches, ring sensors, clothing tags, necklaces, and skin patches
- Supervised calls/app. These connect the person consuming drugs to a person or machine that can monitor whether the person calling is responsive and can otherwise activate an alert

The most common indicators of OD detected by sensors include respiratory rate (the most common), motion, response to prompts, oxygen saturation, heart rate, temperature, and pressing a button.

6. First Responder Applications

Twenty-two different applications were identified for responding to drug use and overdose. To identify the relevant applications, different keywords (such as overdose, and naloxone) were used to search the application markets on different platforms (IOS and Android). To allow for a wider range of results and avoid restriction of particular developers (from certain countries), the search was done incognito. The analysis of the applications led to identification of three key categories:

1- Information applications: provides information related to overdose, naloxone and how to use it when it is needed and information about response to overdose situations. We identified ten applications in this area. Generally, most of these applications are developed as static pages (web 1.0) i.e., information sourced from a static server's file system. These types of apps do not need a constant internet connection, except for their installation.

2- Responder applications: monitors individuals using drugs to avoid overdose. We identified ten applications in this area. In this group of applications, which the users play a role

in the system, users check in on the apps using different methods to activate the application while starting to use drugs. The app checks the responses of people, and if it detects that they need help, the app will start communication with supporters or the emergency centre.

3- Naloxone responder applications: connects people who are carriers of naloxone to individuals who need it. These apps (two identified) enable anyone (bystanders who witness a suspected overdose) to send a request to nearby registered naloxone carriers. If nearby carrier who received the request, accepts it, the app guides them to the situation.

Categories 2 and 3 use volunteers which means they provide a type of co-service.

7. Conclusion and recommendations

7.1. Overdose detection devices

Many of these devices show promising features that could be applied to the Scottish context. A major factor will be acceptance by users and responders. Our focus groups have shown a high level of acceptance for these devices at a first stage. The capacity of a solution of being comfortable, discrete, durable and reliable, among others, will be of great importance.

The implementation of wearable devices and supervised consumption systems that can be utilised outdoors will be important for those who want to protect themselves when using drugs on the street or at someone else´s home.

Any solution we propose should take into account that many PWUD in the higher age ranges are not highly digitally literate, as some focus group participants noted. This should not deter us from providing technical solutions but highlights the fact that they should be tailored to individuals and provided along with appropriate training. Also, when it comes to wearables, it is very likely that smartphones are needed to connect the device with cloud services.

It should be considered that two types of devices could be implemented in parallel.

1- Fixed, room-based devices that are readily available, could be deployed in shelters for homeless people, facilities for temporary housing, and apartments where PWUD live, as well as other spaces where local experts know that ODs occur, like public washrooms in certain areas. From what we have gathered from our focus groups these have a high level of acceptability by both PWUD and service providers and could be further implemented and piloted with relative ease in facilities and homes. However, these devices only protect PWUD when they are in the room where the sensor is fixed and therefore do not provide a complete solution.

2- Mobile, wearable devices, which are mostly in an experimental phase, could be developed and adapted to the Scottish context. Wearables that are already used to detect opioid, could be adapted to this end, In order to do this, further knowledge of the needs and preferences of PWUD in Scotland is necessary. Our ongoing gap analysis through focus groups will continue to provide insights on this. We can already say that the aspect of safety is very important, as highlighted by both PWUD and service providers. These devices should be easy to hide and not attract the attention of others. Also, personal data should be protected, considering that the user of such technologies might act chaotically or under coercion from others at some point, and therefore, there should be a structure in place that accounts for this. From our review of available devices, we have not found one that has all of the characteristics that we are looking for: stealth, comfort, easy maintenance, accuracy, reliability and affordability. However, many of them are very close and with adaptations could meet the

needs of our target group. For this reason, we think a good solution would be to create an 'innovation fund' type call, where a limited number of companies or research groups present a proof of concept and compete for a procurement. The best one or two devices could then be selected for a pilot in Scotland, with the final aim of widespread implementation.
3- Supervised consumption lines/apps, such as the ones developed under first responder applications, which do not require as great technical development, especially in terms of hardware, as the other two options, could also be quickly implemented, giving PWUD another option to use substances with an extra layer of safety. In order for these technologies to be widely used, smartphones and training in their use should be provided.

7.2. First responder applications

We recommend taking a two-step approach. In step one, which is a short-term approach, we recommend the use of two or three applications which are ready to be piloted in different geographical areas. This would help to identify challenges and opportunities in the use of digital technologies (e.g., Fife, Dundee and Aberdeen who have expressed an interest).

In step two, the longer-term approach, we recommend developing a modular application with a core database. Different modules, which can be designed to work separately or in an integrated way, can be researched and developed by different teams. Different types of technologies can be used for various purposes: e.g., responder app to use AI or machine learning to find a new methodology for overdose detection. In this long-term plan, we can use the experience of implementing standalone applications used in the short-term phase, in order to develop and implement the new modules. In this way, we provide a short-term plan to save lives now and a long-term plan to offer an enhanced bespoke solution.

Acknowledgements

We would firstly like to thank all of our participants who took the time to contribute to the focus groups. Secondly, we would like to acknowledge the support we received from a number of organisations to undertake this research at such a challenging time. Thanks to the University of Stirling's General University Ethics Panel for providing swift ethical approval.

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